XXIV WORLD ROAD CONGRESS
MEXICO 2011

SPAIN – NATIONAL REPORT

STRATEGIC MATTER A – SUSTAINABILITY OF ROAD TRANSPORT:
"REDUCTION OF THE IMPACT OF ROADS ON CLIMATE CHANGE"

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SUMMARY

The effect of transport on climate change is an especially serious matter as it is the source of three of the six main gases which, in accordance with the Kyoto Protocol, contribute to the greenhouse effect. In Spain the greenhouse gases (GHG) caused by transport activities make up 25.4% of the total amount of gases produced, which although this is much less than the 50% caused by industry, far exceeds that of agriculture. In terms of the modal share, roads are the cause of 89.2 per cent of emissions, with 53.2 per cent corresponding to cars and motorbikes, 33.5 per cent to heavy vehicles (buses and trucks) and 13.3 per cent to light transport vehicles. The notable effort made by means of regulations about motors and fuels has significantly reduced the specific emissions per unit of energy consumed, although the increase in the demand and the increasing registration of more powerful vehicles or those with diesel motors have counteracted part of the technological efforts. In this report the possible contribution of the road transport system to the improvement of energy efficiency is analyzed from the planning, design, construction or use of infrastructures as well as the management of traffic demand and user information.

1. GENERAL CONTEXT

Transport is one of the most important economic sectors as, in addition to its important characteristics within the sector itself, it contributes to the development and competitiveness of the rest of the sectors. This transversal character makes it much more difficult to integrate environmental considerations in its regulation and development.

Present transport policies aim to achieve a more efficient system and it is certain that by driving economic development, the environment will be protected, social and national cohesion and public health will be favoured and, at the same time, the greenhouse gases (GHG) will be reduced.

The emissions of GHG in the transport sector have been growing continuously in recent decades. According to the latest forecasts carried out, emissions would be the same in 2010 as in 2005, but 27 percent higher than the levels in 1990. For this reason, the Council of the European Union has proposed that, in 2020, a 20 per cent reduction in emissions be achieved in the European Union compared to 1990.

In Spain, the GHG emissions from transport activities exceeded the equivalent of 108 million tons of CO_2 in 2006, which is 25.4 per cent of the total greenhouse gases emission. Although this is much less than industry which causes 50% of emissions, it far exceeds that of agriculture, the sector which produces the third highest amount of greenhouse gas emissions.

This figure represents an increase of 88 per cent with respect to the millions of tons of CO_2 produced in 1990. This increase is directly related to the notable growth in demand, which has translated into the weight of the sector in emissions passing from 21.4 per cent in 1990 to the previously mentioned 25.4 per cent in 2006.

With respect to the modal share, road transport is the cause of 89.2 per cent of emissions, with 53.2 per cent corresponding to cars and motorcycles, 33.5 per cent to heavy vehicles (buses and trucks) and 13.3 per cent to light transport vehicles.

In the distribution per type of road, 49.6 per cent were produced in large capacity roads, mainly in intercity journeys, 36.6 per cent corresponds to the urban field and 13.8 per cent to intermediate situations.

The main actions of the Spanish Public Services organizations to reduce the greenhouse gas emissions are carried out by means of planning instruments: Strategic Plan of Infrastructures and Transports 2005-2010 and their Action Plans, and the Renewable Energies Plan 2005-2010.

To this aim, the European Commission has established voluntary agreements with European, Japanese and Korean private vehicles manufacturers in order to reduce the specific CO_2 emissions of the new cars. In this way, according to a report of this Commission in 2009, the community average of the emissions from new cars was 158g CO_2/Km compared to 185g CO_2/Km in 1995 (in Spain these values were 152g CO_2/Km and 175g CO_2/Km respectively).

As well as the main gas produced by transport (CO_2), there are other gases and contaminating particles, such as carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO_x), sulphur dioxide (SO_2) and particles (PM), which should also be considered in transport plans and studies.

2. EVOLUTION OF ENERGY CONSUMPTION AND THE EMISSION OF CONTAMINANTS DUE TO ROAD TRANSPORT

The emission of contaminants by road transport has important effects on the quality of air and health, even though they are more noticeable in urban and metropolitan areas where congestions and structures of the cities themselves aggravate these effects.

These emissions come mainly from the burning of fuels as well as to a lesser extent, the loss of refrigerating gases.

Four main types of contaminants from road transport can be considered:

- Greenhouse effect gases (GHG): CO_2, N_2O y CH_4
- Precursors of the tropospheric ozone: NO_x, CH_4, COVNM (non-methanic volatile organic compounds) and CO
- Acidifier substances: NO_x, SO_2 y NH_3
- Particles : PM_{10} (particles in suspension on a diameter of more than 10 microns)

The effect of transport on climate change is especially important considering that of the six main gases which affect the greenhouse effect named by the Kyoto Protocol, transport is the source of three of them.

Of the three Greenhouse effect gases named, the most important one produced by road transport is CO_2. Its relationship with transport is clear as it is produced by the burning of fuels (petrol and diesel) in the internal combustion of motors. It is also important for their effect which means that the estimations of emissions of GHG are measured in tons of CO_2.

Coming now to the evolution in Spain of energy consumption and the emission of contaminants, we can see that during the 90s an intense increase was produced (4.3 %

annual accumulative) of the energy consumption and emission of greenhouse gases from road transport, which reached 5.0% in the second half of the decade.

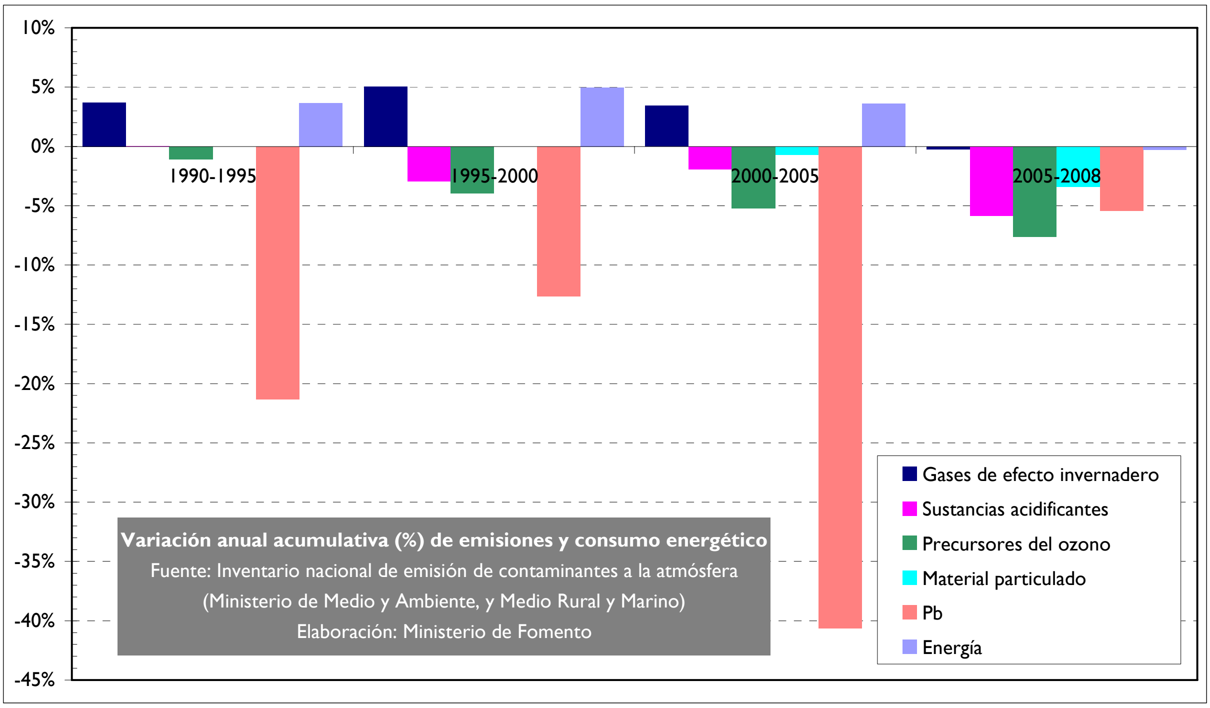

Figure 1. *Variation of the emissions and energy consumption of road transport*
Source: Ministry of the Environment, Countryside and Marine life

This growth slowed down to 3.6% in the first half of this decade, already showing a decrease (-0.3%) in the second half due to the credit crunch and the subsequent fall in economic activity, which affects transport notably.

These tendencies continue in 2009, as according to the Corporation of Strategic Reservations of Oil Products, decreases of 4.5% were produced with respect to 2008 in the consumption of petrol and 5.4% in that of diesel.

The notable efforts carried out by means of regulations on motors and fuels (introduction of catalysers and filters, lead-free petrol and low sulphur content, biofuels, etc.) had notably reduced the emissions per unit of energy consumed, even if the increase of demand and the growing registration of more powerful cars or with diesel motors has counteracted part of the technological efforts, causing a less noticeable decrease in absolute and relative terms.

We can see that the reduction of emissions of acidifying substances have gone from -5% annual accumulative rate in the nineties to -3.4% at present, figures which rise to -2.5% and -6.1% respectively for the ozone precursors. Lead has almost disappeared from fuels and so in 2008 its emissions were less than 1% with respect to the value of 1990.

In the graph in figure 2 we can see the evolution of the energy intensity of the emissions, that is, the quotient between the emission of contaminants and the energy content of the fuels, with respect to the year 2000 (this is used as a reference because it was the first year with data of particulate matter).

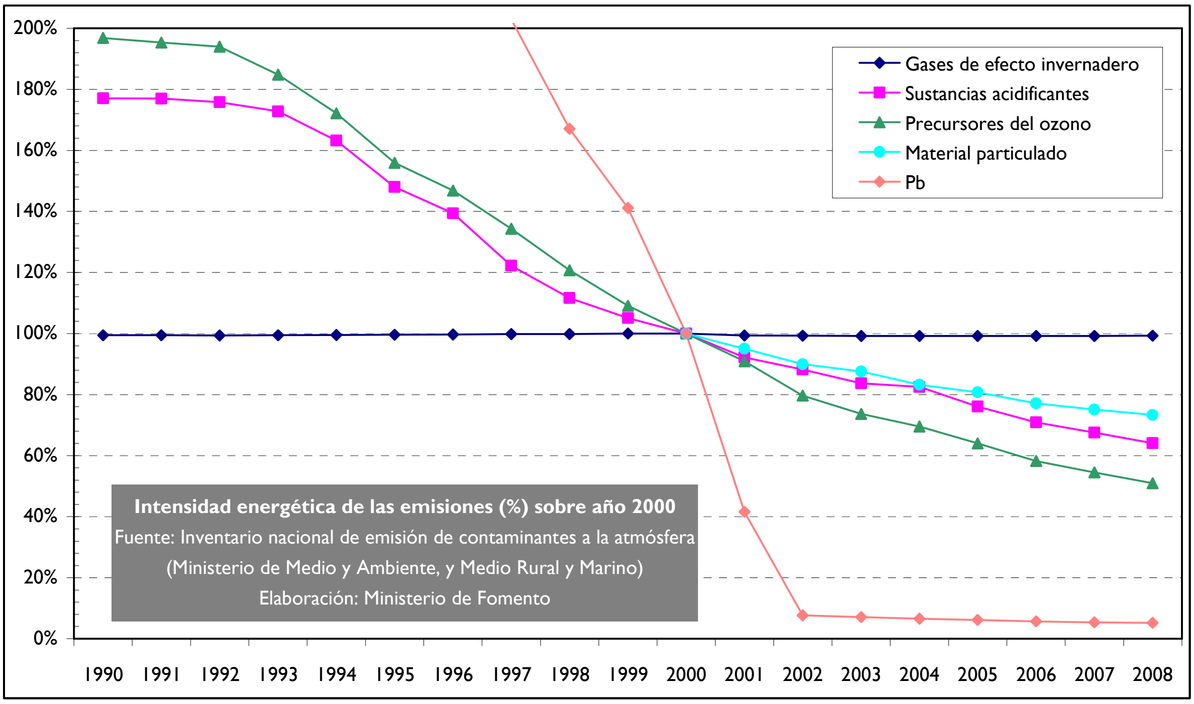

Figure 2. Variation of the energy intensity of the emissions
Source: Ministry of Environment and Countryside and Marine life

The evolution of the acidifying substances and ozone precursors has been constant since the mid-nineties due to the renewal of the vehicles park and the introduction of stricter European regulations, while for the greenhouse effect gases have remained practically unchanged. The relation between the emission of carbon dioxide and energy content of the fuels is constant. There was only a small decent during recent years attributable to the growing use of biofuels.

With regards to the energy consumption according to vehicle type, during the nineties this grew at higher levels to 5% annual accumulative variation in cars and light vehicles, which remains at about 2% this decade.

On the other hand, for heavy vehicles such as motorbikes, the growth has been more intense in this decade, despite the effects of the credit crunch in recent years.

Figure 3 shows that, practically since 1990, cars are responsible for 60% of energy consumption, while heavy vehicles and buses contribute another 30%.

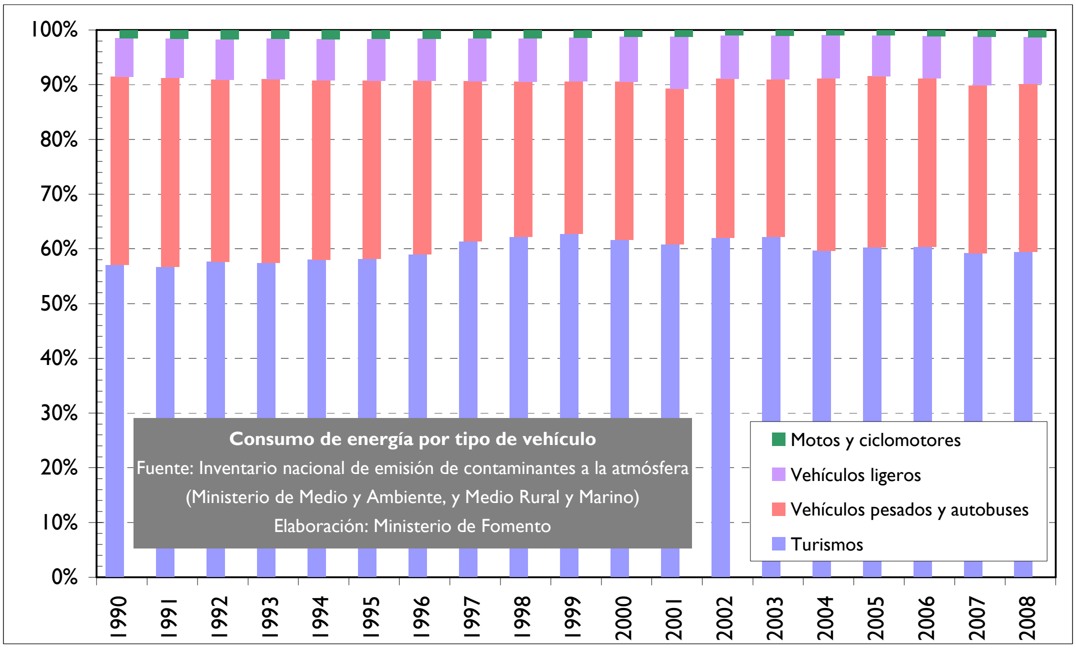

Figure 3. Distribution per type of vehicle of road transport energy consumption
Source: Ministry of Environment and Countryside and Marine life

With regards to the driving guidelines (or type of traffic according to its journey), in the nineties the increase was higher in the urban areas (5.3%) than in intercity journeys (3.9%) and short journeys or rural areas (3.5%). These increases are less intense this decade, and the intercity journeys (2.6%) even exceed those of the urban areas (2.0%). However, the distribution between driving guidelines has remained unchanged since 1990, with half of the energy consumption associated to intercity transport, and the remaining 2/3 corresponding to urban areas, as can be seen in the graph in figure 4.

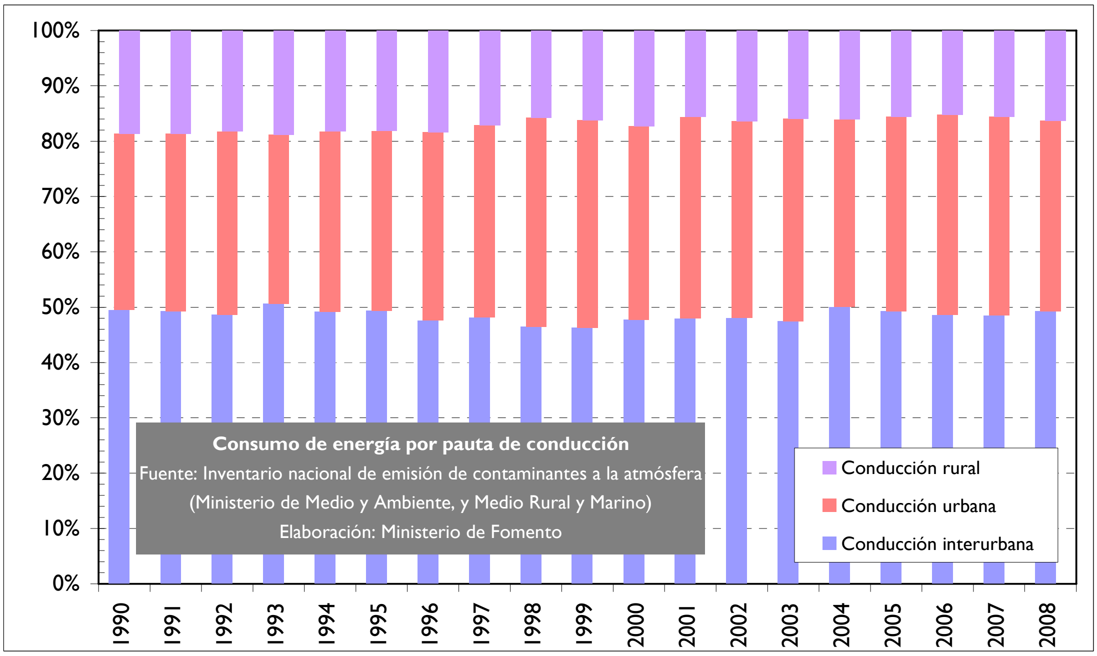

Figure 4. Distribution by driving guidelines of the energy consumption of road traffic
Source: Ministry of Environment and Countryside and Marine life

3. GENERAL LINES FOR THE CONTRIBUTION TO THE IMPROVEMENT OF ENERGY EFFICIENCY AND THE FIGHT AGAINST CLIMATE CHANGE

The road transport system presents different possibilities for contributing to the improvement of energy efficiency which will also benefit better sustainability and a reduction of greenhouse gases.

In reference to the main elements to highlight in order to carry out this contribution to the fight against climate change, we can organize them in various groups in accordance with the concept where the actions to be taken are included:

3.1. Planning of infrastructures

With the planning of infrastructures we can carry out a diagnosis and prognosis that programmes the necessary actions and organizes the traffic by means of an appropriate rationalization of the network.

In this way an attempt is made to avoid or reduce traffic congestions that are an important cause of greenhouse gas emissions.

3.2. Design of infrastructures

In the design of infrastructures an important element for the reduction of energy consumption and the decrease of emissions is the reduction of slopes on the roads. Achieving an optimized section in this aspect constitutes a good option for obtaining our objectives within the limitations of the orography of the land.

3.3. Construction of infrastructures

During the construction of infrastructures, techniques and solutions can be employed that contribute in one way or another to the environmental sustainability.

The following solutions stand out:

- recycling of tyres for the Road surface, which means a double effect for the value of a waste material and an increase in the durability of the road surface.
- the management and reuse of construction waste, with a clear effect
- efficient and intelligent lighting in lineal infrastructures, whether by using new technologies in LED bulbs which greatly reduce the consumption with the performance itself, or by programming the activation and deactivation of the lighting in the corresponding sections in accordance with a timetable, the intensity of natural light or even in accordance with the detection of the passing of vehicles in quiet sections of road. It is also possible with the present technology to adjust the intensity of each light according to the circumstances, toning down the light and therefore the consumption, when a more intense light is not necessary.

3.4. Use of infrastructures

There are various possibilities to reduce the emission of greenhouse gases in terms of use of infrastructures, even if in general the aim of the majority is mainly the reduction of the number of vehicles by means of the increase of public transport and intermodality.

In this case the benefits can be doubled as on the one hand, the number of vehicles circulating is reduced in relation with the number of passengers, and therefore the emissions are reduced and on the other hand a decrease in traffic jams is achieved as there are less vehicles circulating, with an additional reduction of emissions.

The use of roads reserved for public transport or high occupation vehicles, the installation of transport interchanges, the use of disused car parks or the placement of bus stops also stand out.

Obviously, in these cases appropriate planning is of great importance in which these elements are predicted and where the accesses to ports and airports as points of intermodal exchange are also contemplated.

In addition to measures aimed at reducing the number of vehicles, others aim to improve the energy efficiency of them. In the case of urban areas can be accomplished by limiting the speed of vehicles adapted to the optimum speed to facilitate traffic flow, because if there are big differences in speed between vehicles can be damaged this fluidity.

3.5. <u>Vehicles and fuels</u>

In terms of vehicles and fuels the main course of action for the reduction of emissions is:

- the promotion of technological development and sales of hybrid and electric vehicles, with grants for their investigation and technological development, incentives for buying it for the users and for their use, the installation of a network for recharging so that it there is no inconvenience for the users.
- promotion of efficient vehicles in the fleets subject to concession
- registration tax in accordance with the $CO2$ emissions
- recycling of vehicles at the end of its operational life
- the use of biofuels

3.6. <u>Management of traffic demand</u>

In a way that is particularly linked to the use of the infrastructures, another way of reducing emissions is by managing the traffic demand.

A very effective measure to take is the promotion of car pooling. It involves sharing the use of one car by two or more people, generally to travel during peak hours to work or to school. Generally, all the participants are owners of a car and alternate the use of each vehicle, economizing en travel costs and contributing to reducing traffic congestion and decreasing the emission of greenhouse effect gases.

Another measure for the management of the demand is the installation of parking metres in the cities, which means a charge for parking for the user and a limited parking time that persuades travellers in favour of public transport or makes people avoid journeys which are not completely necessary.

The establishment of traffic restrictions and/or tolls in order to circulate in certain zones, generally urban areas, has proven useful for the management of demand, resulting in people using public transport more often or avoiding journeys which aren’t completely necessary.

3.7. Traffic information

Providing travellers with adequate information about traffic may also produce a reduction of emissions. In particular, intelligent transport systems and information systems about traffic give the possibility to the traveller of optimizing trips and even allow them to choose the most appropriate means of transport. In this way, they can avoid traffic jams and also contribute to the possibility of being able to resolve these as opposed to aggravating them.

Clearly, there are other elements for improving road transport sustainability (reduction of accident rates, decrease of noise, measures for reducing negative effects of the fragmentation and occupation of the territory, etc.) that have not been quoted because there are not directly related to climate change.

4. REDUCTION OF CONTAMINATING EMISSIONS FROM ROAD TRANSPORT BY MEANS OF EFFICIENT PLANNING AND USE

For the revision of future emissions of the road transport sector the planning studies are based on real, official figures from:

- The present number and predicted number of vehicles, distributed by category, fuel type and payload.
- The length and type of sections of the initial road network and that foreseen in the PEIT (Strategic Infrastructures and Transport Plan) 2005-2010
- The average speeds of the different types of vehicles per section, measured and predicted with the planned actions
- The average daily intensity of traffic in each section of the network, and the fuel consumption in accordance with the type of vehicles (petrol and diesel), the type of journey (intercity, periurban and urban) and their ages.

The predictions for 2020 about the total number of cars in Spain indicates a gradual rejuvenation with a reduction of 30 per cent of light petrol vehicles and a growth of 80 per cent of the total diesel vehicles, which would make the percentage of the light petrol vehicles go from 61 to 100 in 3004 to 30 per cent in 2020. The possible sudden inrush of electric cars, which is foreseeable especially in urban settings, has not been taken into consideration.

The average annual length travelled by each vehicle in interurban travels remains constant and the urban and periurban trips increase, taken by the oldest and most contaminating part of the total number of vehicles.

The results of the predictions made indicate that with new vehicle technology it will be possible to reduce the emission of carbon monoxide and volatile organic compounds, lightly increasing the nitrogen oxides and significantly increasing those of CO2, which could grow as far as to 20 per cent in 2020 if measures are not taken to transfer traffic to more efficient means or to collective road transport, without taking into account the technological changes in the vehicles.

In the PEIT the improvement of environmental transport behaviour is describe in two fields: the decrease of global impacts of transport (mainly in reference to climate change) and environmental quality in the natural and urban environment.

In order to achieve this, a comprehensive transport system is put in place in a complementary, coordinating framework between the different means and between the infrastructures and services subject to the different Authorities and Bodies, and the optimization in the use of existing infrastructures is looked for by means of demand management measures, which with reference to the road are based on:

- The improvement of accesses and transports services of public transport to terminals of different means.
- Construction of roads reserved for public transport and busy roads.
- Provision of parking for unused vehicles in metropolitan stations.
- Limitation of vehicle speed in order to reduce the energy consumption.
- Modernization and renovation of fleets of vehicles.

Having established the framework for efficient road traffic transport in the Strategic Plan, in the planning phase (how to achieve this) action has been taken by means of the consideration of the influence of design and use in the reduction of the contaminating emissions. A specific methodology has been developed for this that takes into account, in the alternative actions study phase, the emissions generated by the different suggested solutions.

The methodology developed analyzes the most determining factors in the emissions of the different gases considered, with the aim of being able to evaluate possible actions that, during the study phase (planning and project) reduce them.

The variables to be taken into account are the environment, the type of road, the transversal section, the accesses, the Project speed, the gradients, the overtaking distances, etc.

In addition, the methodology applied also analyzes the factors that determine these emissions during the exploitation phase: traffic intensity, types of vehicles, circulation speeds, etc.

The methodology applied is based on COPERT 4 and ARTEMIS projects of the European Environmental Agency, in which each type of vehicle is assigned a formula for calculating the emissions of each contaminant in accordance with the average speed of the trip, which is established by means of the American Capacity Manual (HCM 2000) in the study phase and with real data of speed measurements with floating car data in the exploitation phase.

In order to calculate them the characteristics of the Project are determined or the measurements of exploitation that reduce the quantity of emissions of each gas the most. With this, it is possible to include this variable in the selection of materials multicriteria analysis

Therefore, factors such as the inclination of the gradient, the number of lanes and their breadth, the hard shoulders, the project speed, the speed limitation, etc. will influence the emissions of contaminating gases significantly (NO_x, CO, CO_2, CH, PM).

From experiences in environments with intercity highways follows that the slowing of project virtually no effect on CO2 emissions and therefore can not be considered a useful measure for this objective in this kind of roads

On the other hand, allowing steeper gradients (up to 6 per cent) means increases of more than 50 per cent in the emissions of CO_2 and NO_x due to the higher fuel consumption due to the necessary increase in power and despite the decrease in speed.

In urban settings, the reduction of the breadth of the circulation lanes also means an important saving of emissions, especially in NO_x. With this, it is possible to reduce the speed of passing vehicles if this is too high, achieving in this way a reduction of emissions without infringing on the capacity, which can even benefit if the speed is near the optimum capacity. In addition, with the reduction of the breadth of the lanes (up to 3m), the number may be increased, which as well as an improvement in capacity also brings other improvements such as the reduction in the level of noise.

In the urban access motorways the construction of BUS-VAO lanes is the most efficient measure of those analyzed as it can lead to a reduction of more than 80 per cent in CO_2, considering that an induction of new private vehicles traffic is not produced and that the transfer of travellers to collective transport allows the existing congestion to be resolved.

In the exploitation phase the installation of a dynamic signposting system, for speed reduction in accordance with the traffic considerations, reduced the emissions of CO_2 in approximately 30 per cent and those of NO_x in 40 per cent.

The traffic restrictions of heavy vehicles also achieve significant reductions of emissions that may exceed 20 per cent in CO_2.

In the information studies carried out in the Traffic Department of the Ministry of Public Works for comparing alternative sections for a determined stretch or road itinerary has also used the calculation of emissions as one more variable of the multicriteria method, that analyzes economic, environmental, functional and territorial variables.

The results indicate that, in general, there aren’t generally large differences between the alternatives from the point of view of emissions, having similar project speeds and characteristics, with the differences in length being the most determining factor. However, although the absolute values tend to be similar, there are differences that can reach up to 20 per cent in CO_2 and NO_x.

Therefore, the reduction in the steepness of the gradient, decreasing the breadth of the carriage and lanes in urban areas and the creation of BUS-VAO lanes are the most interesting actions from the point of view of the reduction of contaminating emissions with NO_x being most sensitive and in second place CO_2.

5. CONCRETE APPLICATION THAT REDUCES THE IMPACT OF ROADS ON CLIMATE CHANGE

The principle of sustainability is increasing in importance day by day all over the world and in every field, with roads logically being one of them. The objective is to look for the lowest overall cost possible in the three aspects in which sustainable development is conceptually supported: socially, economically and environmentally.

In the wager for sustainable construction of road infrastructures, it is necessary to combine the actions in various lines at the same time: the impulse of rational use of resources and materials, the development of new technologies and the improvement of the overall durability.

Like materials and technologies directly related to sustainability in road surfacing, the following are being encouraged by the Traffic Department of the Ministry of Public Works:

- Use of Powder from Out-of-Use tyres in binders and bituminous mixtures
- Recycling of road surfaces
- Tepid and warm bituminous mixtures
- Cold micro mixtures

5.1. Use of powder from Out-of-Use tyres and bituminous mixtures

In relation with the powder from out–of-use tyres, and following what was established in the Integrated National Plan of Waste Materials 2008-2015, approved by Cabinet Agreement of 26th December 2008, the Public Administrations should promote the use of powder from the out–of-use tyres in public works and in particular, in the bituminous mixtures for the construction of roads, as long as this is technically and economically possible.

The experimental sections constructed and the experiments carried out in recent years have made the development of specific technical regulations possible which has been the key to the boost of this technology as different procedures are defined in it, criteria and fields of application are established and its use is prioritized as long as it is technically and economically possible, developing in this way what was established in the aforementioned legal framework.

Two types of procedure are defined:

- DAMP ROAD: this consists of the mixture at a high temperature of powder from out-of-use tyres with penetration bitumen in a fabrication plant of modified asphalts or in installations in situ located on the same fabrication plant of bituminous mixtures.

  With this procedure, three new types of asphalts are defined in the regulations and the specifications that have to be fulfilled are established. These three new types are:

  - Asphalts improved with rubber
  - Asphalts modified with rubber
  - High viscosity Asphalts with rubber.

- DRY ROAD: which involves adding the rubber powder from out of use tyres directly in the bituminous mixture roller machine as if it were an arid mineral. The product obtained is called hot bituminous mixture with addition of rubber in Spanish legislation.

By using these different types of applications a very significant consumption of out-of-use tyres is generated in our road surfaces, especially with the asphalts improved with rubber for which the same conditions and layers are established as the normal asphalts.

These asphalts improved with rubber, with respect to a a penetration asphalt of the same grade, provide a higher softening temperature, an improvement of the thermal susceptibility, more viscosity and an increase in elastic recuperation.

The bituminous mixtures manufactured with them follow the same formulation, manufacturing and execution systems and present an improvement of the resistance to plastic deformations as its most outstanding property.

In terms of other properties of the mixtures, it seems that it improves the resistance to fatigue, although this is an aspect which is still being investigated, the module values are somewhat lower and the sensitivity to water and the superficial characteristics of the mixtures are similar.

In conclusion, the present state of the technique allows its generalized use in road works which not only means the reuse of a waste product but also improves the durability of the road surface, therefore having a bearing on two complementary aspects of sustainability.

5.2. Recycling of asphalt and cement road surfaces

Also in relation to the rational use of resources, the use of materials on the road itself should be highlighted; materials which due to their age have reached the end of their operational life and it is therefore necessary to remove and replace it by means of structural and superficial renovation of the road surface.

Although the different recycling techniques are included in the technical regulations of the Ministry of Public Works since 2001, its use still has not been generalized, and the statistics about recycling rates show values far below the possibilities.

The present technical legislation includes general technical prescriptions guidelines for three different recycling techniques of road surfaces: recycling with cement, cold recycling with emulsion and hot recycling of bituminous mixtures.

The renovation regulations establish the criteria and fields of application for each one of these techniques and make it obligatory for a technical and economic study about the recycled materials of road surfaces to be carried out.

As well as this specific recycling regulation, the possibility of including up to ten per cent of bituminous mixtures from planing the road as if it were just another arid element should not be forgotten. This practice, although it has a low recycling rate, provides a simple and immediate method of making the most of waste materials from planing the old layers of the road, with very simple adaptations in the asphalt and without the need in general to carry out any special studies on the formulation of the mixture.

In short, the recycling techniques of road surfaces are becoming more and more relevant. On the one hand, due to the increase of conservation works instead of new construction, and on the other hand due to the growing importance of the sustainability principle in construction which encourages the decrease of the generation of waste materials as well as the consumption of natural resources.

The present state of technology allows for the application of various recycling techniques, with different applications and recycling rates. It is now necessary to promote the generalization of its use in all road works, which since 2009, includes the obligation to specify the use given to all the planed material from the road surface by using cold and hot recycling techniques in the writing of structural and superficial renovation of road surfaces projects.

5.3. Application of semi-hot and tepid bituminous mixtures

Within the development of new technologies related to sustainability, the drive to use bituminous mixtures in which the manufacturing temperatures and use in road works are less than those necessary for the conventional hot bituminous mixtures, are becoming more relevant. In this way, energy consumption and CO_2 emissions are reduced and security and health conditions are improved in the road works.

This type of technologies is classified in two groups in accordance with the manufacturing temperature:

- The semi-hot mixtures manufactured and used in road works above 100ºC (some 20 to 30º less than the conventional mixtures)
- The tepid mixtures that are manufactured and used in road works below 100ºC.

For both types there are various alternatives of procedures and materials to achieve the reduction in temperature.

Although a specific regulation has not been established yet, various experimental sections have been carried out and there is growing interest in extending the experience and boosting this technology.

5.4. Cold Micro binding

As a last road surfacing technology related to sustainability, although it is not a new one, the cold micro binding papers in superficial renovation should not be forgotten.

By using the revision of technical prescriptions about this unit of works, motivated by the coming into effect of the European regulations, the function of cold microbinding for the improvement of the transverse friction coefficient and macrotextures is being driven and highlighted, improving the quality of the materials and execution techniques.

In conclusion, we have various road surfacing technologies related to sustainability. It is necessary to drive and generalize the use about which sufficient contrasted experience has already been had and proceed with the investigation, development and innovation of those that are already in a less advanced stage.

Lastly, as well as the techniques already mentioned, it is also necessary to continue in the investigation of low noise road surfaces in accordance with the present requirements and as a new challenge for the future, in the long lasting road surfaces, as durability and sustainability are directly related.